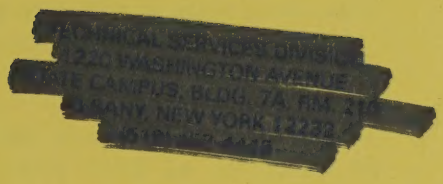
NEW YORK STATE
DEPARTMENT OF TRANSPORTATION



LEAD BASE PAINT REMOVAL ACTION PLAN

Approved
JULY 26, 1988

MATERIALS BUREAU
TECHNICAL SERVICES DIVISION

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ADDENDUM TO THE NEW YORK STATE DEPARTMENT OF TRANSPORTATION
LEAD BASE PAINT REMOVAL ACTION PLAN
APPROVED JULY 26, 1988

The report listed above is modified to incorporate the suggestion made by the New York State Department of Environmental Conservation dated November 15, 1988 which provides for the following:

Paint waste sample should be split in half. One sample should be laboratory tested for EP toxicity while the second half is retained at the job site. If the first half sample results are in the range of 5.0 to 8.66 parts per million, then the second sample should be laboratory tested also. If the second half sample test results are 5.0 parts per million or greater then the material is to be considered hazardous. If the second half sample are below 5.0 parts per million the material can be considered nonhazardous.

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BACKGROUND

In 1986 the New York State Department of Transportation in cooperation with the New York State Department of Environmental Conservation adopted a policy for containment of sandblasting debris generated by paint removal on bridges. That policy provides for the environmental protection of areas inhabited by people, land devoted to agriculture, and waterways. Engineering Instruction (EI) 86-19 which details that policy is included as Appendix A to this document.

After the adoption of that policy the Department was alerted to the fact that the sandblasting debris collected under this policy might require special handling if it contained more than 5 parts per million of lead. To investigate that possibility the sandblasting debris was sampled at 7 bridges and tested for toxicity according to Department of Environmental Conservation regulations. That investigation showed that at least some of the bridges yielded debris which could be classified as a hazardous waste for purposes of solid waste disposal. Unfortunately it was also demonstrated that the EP Toxicity Test yielded highly variable results which makes the toxicity determination highly uncertain for an individual bridge. Those results are described in an April 11, 1988 memorandum from J. J. Murphy to G. R. McVoy, Appendix B.

Because of the uncertainty over the potential toxicity of debris from any individual bridge, the Department elected to store the debris being contained pending determination of its toxicity and the appropriate procedures for its disposal either as solid or hazardous waste. The Department's actions are detailed in a May 16, 1988 memorandum from Richard Simberg to All Regional Directors, Appendix C. To address the problem of stored debris on current contracts and the control of debris on future contracts, the following action plan has been developed.

For informational purposes, Appendix F to this document is a summary of the current painting and paint removal practices of 9 other states.

LEAD BASE PAINT REMOVAL ACTION PLAN

I. ONGOING CONTRACTS - RECOMMENDED ACTIONS

A. Storage of Waste

1. Sandblasting debris will be stored at the job site in closed containers until the completion of paint removal operations if space permits.

2. For contracts where adequate space is not available, the contractor will be required to move the containers to an alternate site designated by the Department. The contractor will be required to prepare the storage site under a negotiated price. If the region is unable to negotiate an acceptable price, the work will be progressed under force account.

3. The Construction Division in concert with the Highway Maintenance Division will develop a policy to identify interim storage sites for temporary retention of debris pending toxicity testing. The policy will be implemented for individual contracts by the Regional Construction Engineer and the Regional Highway Maintenance Engineer.

B. Sampling Stored Waste

1. Sampling will be done by inspection firms under contract to the Department. Appendix D describes the sampling protocol to be employed.

2. A single composite sample will be taken and split in half. One half is to be forwarded to a testing laboratory under contract to the Department , one half is to be retained by the Engineer at the job site for possible additional testing if necessary.

C. Toxicity Testing of Stored Waste

1. The Materials Bureau has developed contract specifications for conducting the toxicity test to ensure appropriate test methods and rapid turnaround.

2. The Administrative Services Division will let a contract for testing by qualified laboratories.

3. The Construction Division will notify the regions of the testing contract award and procedures for shipping the samples to the laboratories.

4. The testing laboratory will perform the toxicity test within 2 weeks and forward the results to the Engineer with a copy to the Materials Bureau.

D. Waste Disposal

1. If the stored debris is determined to not be hazardous, the Engineer will direct the contractor to dispose of the debris in accordance with existing state, federal, and local regulations as required by the contract specifications for containment. Appendix E describes the statistical methodology to be employed in the determination.

2. If the stored debris is determined to be hazardous, the Engineer will contact the Department's hazardous waste disposal contractor to arrange for disposal in accordance with DEC regulations.

3. The Materials Bureau has developed contract specifications for the disposal of hazardous waste in accordance with DEC regulations.

4. The Facilities Design Division will prepare PS&E to let hazardous waste disposal contract(s).

5. The Environmental Analysis Bureau will develop the required hazardous waste documentation and recordkeeping procedures.

E. Program Review

1. The Materials Bureau will collect the results from all toxicity testing on ongoing contracts. The results will be reviewed to determine appropriate changes to improve the accuracy of future sampling and testing of paint removal debris.

II. FUTURE CONTRACTS - RECOMMENDED ACTIONS

A. Projects Let But Not Yet Awarded (Including Future Lettings Too Late To Amend)

1. Maintenance painting contracts will not be awarded because they would apply additional lead paint to numerous bridges.

2. Bridge rehabilitation contracts will be awarded with subsequent negotiation of waste storage cost where containment is included in the contract.

B. Projects Advertised For Letting Which May Be Amended

1. Maintenance painting contracts will be withdrawn from future lettings until revised surface preparation, painting, containment, and disposal specifications which reduce the economic impact of paint removal operations are developed.

2. The Structures Division will amend all contracts involving bridge painting other than maintenance painting contracts to mitigate the impact of paint removal operations. Full repainting of bridges will be deleted. Surface preparation will be confined to areas affected by structural work and deteriorated paint. Repainting will include only a primer and top coat. Revised containment items incorporating storage will be substituted for the present items when containment is required by EI 86-19.

C. Future Projects

1. A non-toxic paint system will be specified.

2. The Materials Bureau will revise the current environmental protection specifications to include temporary storage of the debris. A separate disposal item for debris which has been determined to not be hazardous will also be prepared to separate payment for disposal from other costs.

3. Projects including bridge painting shall be reviewed in accordance with EI 86-19 to determine the required environmental protection.

4. Project designers shall review each project to determine if adequate space exists to store the debris until it is tested. If adequate storage space is not available on the project site, the designer shall contact the Regional Highway Maintenance Engineer to arrange for temporary storage at Department facilities. Any site preparation necessary for temporary storage must be included as a pay item in the contract.

5. During construction the debris will be stored in closed containers until 25% of the paint removal work has been completed or until 3 tons of debris have been collected, whichever occurs first. At that time the Engineer will initiate sampling by the inspection firms under contract to the Department. A single composite sample shall be taken and split in half. One half is to be forwarded to a testing laboratory under contract to the Department, one half is to be retained by the Engineer at the job site for possible additional testing if necessary.

6. The testing laboratory will perform the toxicity test within 2 weeks and forward the results to the Engineer.

7. If the stored debris is determined to not be hazardous, the Engineer will direct the contractor to dispose of the debris in accordance with existing state, federal, and local regulations.

8. If the stored debris is determined to be hazardous, the Engineer will contact the Department's hazardous waste disposal contractor to arrange for disposal in accordance with DEC regulations.

D. Long Range Actions

1. The Materials Bureau will investigate the best available technology to reduce the volume of debris produced by paint removal operations, and to determine the most appropriate policy for its use considering the potential impacts on cost, worker health and safety, public health, and environmental protection.

APPENDIX A - ENGINEERING INSTRUCTION 86-19

BRIDGE CLEANING & PAINTING ENVIRONMENTAL PROTECTION

TO.

ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: BRIDGE CLEANING & PAINTING
ENVIRONMENTAL PROTECTION

Subject Code: 7.27-1-570

Distribution:

31 Main Office ( ) ~~33~~ Regions 34 Special

Code: EI 86-19

Date: 4-9-86

Supersedes:

APPROVED:

J. H. SHAFER, ASSISTANT COMMISSIONER, OFFICE OF ENGINEERING

The Department of Environmental Conservation has expressed concern for the possible adverse environmental effects of our bridge cleaning and painting projects. Their primary concern is for the lead paint chips in the sandblasting debris which could present a health hazard if ingested by humans. This subject is discussed in more detail in the National Cooperative Highway Research Program Report 265 "Removal of Lead-Based Bridge Paints."

In response to these concerns and in accordance with the NCHRP report, we have developed the attached specifications and serialized pay items which are to be used on projects in accordance with the following established policy.

- Environmental Waterway Protection items are to be provided for all structures over water.

- Environmental Ground Protection items are to be provided for these structures over areas where people live, work, walk or play. This includes land use areas as residential, recreational, schools, offices and other work areas. Areas that could generally be considered for exclusion could be railroad land areas, freeways where human exposure to paint chips is minimal and rural areas infrequently occupied by people or livestock.

No doubt there will be contracts where the mix of several structures will require either environmental waterway or ground potection, or both, and some structures with none.

This Instruction takes effect immediately. For those contracts too far progressed to include the protection items in the proposal, they may be added by order-on-contract.

SECTION 570 - CLEANING AND PAINTING

570-1 DESCRIPTION. This work shall consist of cleaning, priming and painting new and existing (in-service) structural steel; cleaning and painting timber and lumber; cleaning and painting galvanized or aluminum surfaces; and providing environmental protection as specified by the contract documents.

570-1.01 DEFINITIONS.

A. Maintenance Cleaning and Priming, and Maintenance Painting shall mean the cleaning and priming, and painting of existing installations or structures in service.

B. Environmental Protection shall mean the containment, collection and removal of old paint chips, corrosion residues, spent abrasives and newly applied paint (herein after referred to as waste materials) that result from blasting and other cleaning and painting operations performed in the field.

570-2 MATERIALS. All materials and equipment used for cleaning and priming and for painting shall meet the requirements of Section 740, Painting Procedures.

All material and equipment used for environmental protection shall be approved by the Engineer. Any material or equipment that is determined to be deficient or that becomes damaged to the extent that it no longer fulfills the requirements of this specification shall be replaced or repaired as directed by the Engineer, at the Contractor's expense.

570-3 CONSTRUCTION DETAILS

570-3.01 Cleaning and Priming, and Painting New Structural Steel and New Structural Steel Downspout Systems. New structural steel shall be cleaned, primed and painted in accordance with Section 740-01, Painting Metal Structures. New structural steel downspout systems shall be cleaned, painted and paid for in accordance with Section 566, Bridge Drainage System.

570-3.02 Maintenance Cleaning and Priming of Structural Steel. All structural steel members, railings, fascia, downspouts, and other miscellaneous steel items which have been previously painted shall be cleaned and primed unless specifically excluded by the plans, or specifications, or by the Engineer.

The requirements of Section 740-01, D. Maintenance Painting shall apply together with the following:

A. Surfaces to be cleaned shall be identified in the following manner:

Category I: A surface on which the existing paint has deteriorated to the point that it is necessary to clean the surface to bare steel.

Category II: A surface on which the existing paint is in good condition, so that it is only necessary to remove contaminants and to dull the existing paint. Many surfaces will exhibit conditions as defined by Categories I and II, side by side.

B. Surfaces meeting the definition of Category I shall be cleaned in accordance with Section 740-01, Surface Preparation, F. Commercial Blast Cleaning.

Surfaces meeting the definition of Category II shall be cleaned in accordance with Section 740-01, Surface Preparation, E. Brush-Off Blast Cleaning.

To remain in place, paint shall be tightly adhered to Category II (brush-blasted) surfaces after cleaning operations are completed. Tightly adhered paint is defined as paint which cannot be lifted as a layer when a dull putty knife is inserted beneath it. If the Engineer determines that paint remaining on the steel surface after cleaning is not tightly adhered, then that paint shall be removed in accordance with the cleaning requirements for Category I surfaces, until tight paint is reached.

C. Category I surfaces cleaned to bare metal shall have all blasting products removed and shall be painted with one coat of primer daily and before the condition known as flash rusting occurs. All stripe painting shall be performed before the general primer coat is applied.

Primer shall be applied in accordance with the requirements of Section 740-01, Paint Application Methods, except that stripe painting operations shall be performed using brushes only.

All steel surfaces receiving primer shall be absolutely dry prior to primer application.

Cleaning and painting operations shall be performed in such a manner that detrimental amounts of spent abrasive, dust or other contaminants do not fall on wet, newly-primed surfaces.

D. Category II surfaces on which the existing paint is tight, and in good condition need not be primed.

570-3.03 Maintenance Painting of Structural Steel. All structural steel members, all railings, fascia, downspouts, and all miscellaneous steel items which have been previously cleaned and primed in accordance with Section 570-3.02 shall be painted, unless specifically excluded by the plans, specifications, or by the Engineer.

All cleaned and primed surfaces shall be painted two (2) full coats of paint, the intermediate coat and the finish coat, in accordance with the requirements of Section 740-01, D. Maintenance Painting, and the following:

A. The application of the intermediate coat of paint shall not begin until all receiving surfaces have been cleaned and primed in accordance with Section 570-3.02.

   All receiving surfaces shall be clean and dry. If, after the original cleaning and priming, or application of a subsequent coat of paint, receiving surfaces become dirty in any manner, they shall be cleaned again by a method allowed under the requirements of Section 740. The actual method to be used shall be determined by the Engineer.

B. Termination of Spraying or Rolling Operations. The Engineer or Inspector is empowered to terminate spraying or rolling operations temporarily or permanently, in accordance with the requirements of Section 740-01, Termination of Spraying or Rolling Operations.

570-3.04 Cleaning and Painting of Timber and Lumber, Galvanized Surfaces and Aluminum Surfaces. The requirements of subsection 740-02, Painting Timber and Lumber; §740-03, Painting Galvanized Surfaces; and §704-04, Painting Aluminum Surfaces shall apply as applicable.

570-3.05 Environmental Ground Protection. Coverage shall be provided on or over the ground under all structures that are to be cleaned and painted in the field under Sections 570-3.01, 570-3.02 and 570-3.03.

> NOTE: Whenever a structure spans over a railroad, covers shall be placed and maintained in accordance with Section 105-09, Work Affecting Railroads.

Depositing or dropping waste materials into water and onto the ground or roadways below the structure outside the specified containment areas will not be permitted.

Blasting or other cleaning or painting operations shall not be performed when the direction or velocity of prevailing winds causes waste materials to fall outside the containment area. If wind or other factors prevent containment acceptable to the Engineer the Contractor may, with the Engineers permission, use drapes or other means to prevent drift beyond all specified containment areas.

Ground Protection shall consist of the following:

A. Covers or other material, capable of catching and holding waste materials shall be provided on or over the ground under the structure in the work area. A bridge deck or a highway pavement and paved shoulder under a structure from which wastes may be collected and removed by sweeping may be used in place of a cover providing that within that area such usage is confined to lanes and shoulders closed to traffic.

B. The cover provided shall include all areas beneath the structure. The length of the cover shall be determined by the length of the work location, and the width shall be at least 10 feet greater than each side of the area directly being worked on. The cover shall be positioned in such a manner as to contain and prevent the loss of waste materials.

C. Covers on or over roadways or railroads or sidewalks or other similar areas shall not present a hazard of any kind, as determined by the Engineer, and no cover shall remain in place overnight unless otherwise authorized by the Engineer.

D. All waste materials that collect on a bridge deck, or on a highway pavement and paved shoulder under a structure or on covers shall be removed at least once a day or more frequently if directed by the Engineer. No waste material shall remain on the bridge deck, pavement or containment covers overnight.

E. All waste materials shall be removed from the project site and disposed of in accordance with all applicable Local, State, or Federal law, regulation or codes.

F. If approved by the Engineer the Contractor may use other methods or modifications for ground protection that will accomplish the results required by this specification.

570-3.06 Environmental Waterway Protection. Collectors shall be provided under all structures that span bodies of water, waterways, and streambeds, and that are to be cleaned and painted in the field under Sections 570-3.01, 570-3.02 and 570-3.03.

NOTE: Structures that span a navigable waterway may be subject to regulation by the U.S. Coast Guard, the U.S. Army-Corps of Engineers, the N.Y.S. Dept. of Transportation-Waterways Maintenance Division, and the N.Y.S. Dept. of Environmental Conservation. If there is conflict between the regulations of the cited agencies and this specification the regulations of the agencies shall govern. However, the Contractor

shall be required to conform with the requirements of this specification and shall submit his proposal for conformance, for approval by the Engineer, at least fourteen (14) days prior to commencing work. No work shall begin until written approval by the Engineer is granted.

The applicable requirements of Section 570-3.05, Environmental Ground Protection, shall apply together with the following:

A. A collector shall be suspended from the structure and shall, as measured over the water, be at least 10 feet greater in length and at least 10 feet wider than each side of the area on which work is underway. The collector shall be positioned in a manner acceptable to the Engineer so as to contain and prevent the loss of waste materials. The collector shall not remain in place overnight, if in the opinion of the Engineer it presents a hazard of any kind.

B. All waste materials that remain on the collector shall be removed at least once a day or more frequently if directed by the Engineer

C. If it is determined by the Engineer that floating waste materials may form on the water surface they shall be contained from moving upstream or downstream by the use of floating water booms (straw or screens). Floating waste material shall be collected daily, or more frequently, as directed by and to the satisfaction of the Engineer. Straw or screening used in the fabrication of water booms shall be replaced with clean material weekly or as otherwise directed by the Engineer.

D. All waste materials and used straw and screening from dam devices shall be removed from the project site and disposed of in accordance with all applicable Local, State or Federal law, regulation or codes.

E. If the bridge location and characteristics or the surrounding topography do not lend themselves to the specified control measures for waterway protection, the Engineer may approve modifications to meet the intent of this specification.

570-4 METHOD OF MEASUREMENT. Payment will be made at the lump sum price bid.

570-5 BASIS OF PAYMENT. The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work. All work shall be done in a manner satisfactory to the Engineer.

570-5.01 Cleaning and Priming New Structural Steel. Progress payments will be made. Structural steel accepted at the project site in accordance with section 564, Structural Steel, shall be considered cleaned and primed. Payment shall be based upon the percent of structural steel cleaned and primed in accordance with the requirements of §740-01. The percentage shall be computed as the ratio of the number of pounds of structural steel accepted to the number of pounds of structural steel required.

570-5.02 Painting of New Structural Steel. Progress payments will be made. Payment shall be based upon the percent of erected structural steel painted with two coats of paint (exclusive of the prime coat) in accordance with the requirements of subsection 740-01. The percentage shall be computed as the ratio of length of structure painted to the total length of structure.

570-5.03 Maintenance Cleaning and Priming of Structural Steel. Progress payments will be made. Payment shall be based upon the percent of structure cleaned primed in accordance with the requirements of subsection 740-01. The percentage shall be computed as the ratio of length of structure cleaned and primed to the total length of structure.

570-5.04 Maintenance Painting of Structural Steel. Progress payments will be made. Payment shall be based upon the percent of structure painted with two coats of paint (exlcusive of the prime coat) in accordance with the requirements of subsection 740-01. The percentage shall be computed as the ratio of length of structure painted to the total length of structure.

570-5.05 Cleaning and Painting of Timber and Lumber, Galvanized Surfaces and Aluminum Surfaces. Progress payments will be made. They will be based upon the quantity of finish coat material actually incorporated in the work.

Prior to the beginning of any work, the Contractor shall supply the Engineer with the estimated quantity of finish coat deemed necessary to complete the work. The quantity shall be given in gallons. The estimate supplied the Engineer will not be considered final. The Engineer may request a revised estimate at any time during the progress of the work. Failure on the part of the Contractor to supply a revised estimate when requested, will be cause for the progress payment procedure to be immediately terminated.

Progress payments will be based upon the percentage of work completed. The percentage will be computed as the ratio of the number of gallons of finish coat actually incorporated in the work, to the total number of estimated gallons of finish coat required.

570-5.06 Environmental Ground and Waterway Protection. Progress payments will be made. They will be based upon the number of work days required to complete all of the work of cleaning and painting.

Prior to the beginning of any work, the Contractor shall supply the Engineer with an initial estimate of work days required to complete all of the work. This initial estimate shall not be considered final. The Engineer may request a revised estimate at anytime during the progress of the work. The Engineer will determine a daily rate of payment using the estimate of work days and the lump sum bid price. The daily rate will be used to authorize payment in accordance with subsection 102-17, Article 7.

Should the Engineer request a revised estimate and use that estimate to establish a new daily rate, the lump sum bid price shall be reduced by the total of the amounts previously authorized for payment, prior to the establishment of the new daily rate. Failure on the part of the Contractor to supply a revised estimate when requested, will be cause for the progress payment procedure to be immediately terminated.

Progress payments for this work will be made only for days during which cleaning, priming and painting work is actually performed.

Payment will be made under:

Item No.	Item	Pay Unit
570.01	Cleaning and Priming New Structural Steel	Lump Sum (for each Structure)
570.02	Painting New Structural Steel	Lump Sum (for each Structure)
570.03	Maintenance Cleaning and Priming of Structural Steel	Lump Sum (for each Structure)
570.04	Maintenance Painting of Structural Steel	Lump Sum (for each Structure)
570.07	Environmental Ground Protection	Lump Sum (for each Structure)
570.08	Environmental Waterway Protection	Lump Sum (for each Structure)
570.11	Cleaning and Painting Timber and Lumber	Lump Sum
570.12	Cleaning and Painting Galvanized Surfaces	Lump Sum
570.13	Cleaning and Painting Aluminum Surfaces	Lump Sum

NOTE: ALL ABOVE ITEMS ARE SERIALIZED ON THE LAST FOUR DECIMAL PLACES.

PAINTING PROCEDURES

Page 7-193

Under "Surface Preparation, A. General," delete the last sentence in the first paragraph that reads:

"A dry surface upon which light rusting may have formed, after cleaning, shall be considered acceptable."

Page 7-194

Modify the last sentence under the subsection "Paint Application Methods, A. General" to read:

"Paint may be applied by brushes, or rollers, or air-less spray, or a combination of these methods provided the method does not cause damage to public or private property."

Page 7-195

Under the subsection "Termination of Spraying or Rolling Operations" delete lines c. and d. and substitute the following:

c. Areas not specifically designated to be painted are likely to be or are being affected by the application method.

d. The application method is causing damage to public or private property."

Insert the following between the second and third sentences of the second paragraph to this subsection.

Spraying or rolling operations which are terminated due to damage to public or private property shall not be resumed until the Contractor takes appropriate measures to protect such property and demonstrates to the Engineer's satisfaction that such property damage will not recur.

Page 7-196

Under "A. General" revise the third paragraph to read as follows:

" - The protection, from paint spatter or spillage, of pedestrian, vehicular, marine or other traffic upon, beneath or adjacent to the painted surfaces. Payment for this service will be made under the item Environmental Ground Protection, Environmental Waterway Protection or Basic Maintenance and Protection of Traffic as applicable.

APPENDIX B - 4/11/88 MEMO, MURPHY TO MCVOY, "TOXICITY OF BRIDGE PAINTING WASTE PRODUCTS"

TO: G. R. McVoy, Environmental Analysis Bureau, Rm. 303, Bldg. 5

FROM: J. J. Murphy, Materials Bureau, Rm. 210, Bldg. 7A ORIGINAL SIGNED BY RICHARD H. FREDERICK

SUBJECT: TOXICITY OF BRIDGE PAINTING WASTE PRODUCTS

DATE: April 11, 1988

Attached is a copy of Technical Report 88-9, "Investigation Into the Toxicity of Bridge Painting Waste Products". Although the results obtained from testing were somewhat inconsistent, it is reasonable to conclude that some of the debris should be classified as toxic. Due to the inherent variability of the current test method, a more definitive conclusion is impractical. However, this conclusion is consistent with several other states' findings.

There have been indications that the EPA will replace the current test method with a new, more precise and probably more severe test method sometime in the next 12 months. If this comes to pass, indications are that the majority of our bridges will produce toxic debris when sandblasted.

Presently, the only dependable method of determining if the debris from a bridge is classifiable as a toxic waste is to sample and test it once the job has begun.

We are operating under the assumption that your office will continue to handle the administrative aspects of this issue, i.e. policy formulation and liaison with D.E.C. We will continue our current efforts to define the magnitude of the problem and its impact on Department operations.

If you have any questions, please contact Richard Frederick or David Richards at 457-4285.

JJM:DKR:MTS
✓FILE: 8.1

Attachment

cc: Richard Simberg, Ofc. of Engineering, Rm. 504, Bldg. 5 w/att
D. J. Massimilian, Structures, 6th Flr., Bldg. 5 w/att
K. Shiatte, Construction Div., Rm. 101, Bldg. 4 w/att
J. Thomas, Office of Operations, Rm. 505, Bldg. 5 w/att
J. Yourno, Facilities Design, Rm. 405, Bldg. 5 w/att

APPENDIX C - 5/16/88 MEMO, SIMBERG TO REGIONAL DIRECTORS,
"REMOVAL OF LEAD BASED PAINT"

MEMORANDUM
DEPARTMENT OF TRANSPORTATION

TO: All Regional Directors, Region ____

FROM: Richard Simberg, Office of Engineering, 5-504

SUBJECT: REMOVAL OF LEAD BASED PAINT

DATE: May 16, 1988

Paint removal work was recently suspended in order to evaluate the effect of that work on the environment. That initial evaluation is now complete and we find the following:

- Recent EP toxicity tests which have been performed on samples of residues of blast material and paint fragments indicate a large variability of levels of lead content, much of which is below EPA current permissible levels. However, there are sufficient tests above the levels to reasonably conclude the possibility that the waste material at individual sites could be classified as hazardous. We are informed by the Office of Legal Affairs that given this information, actions must be taken.

  We are progressing rapidly with testing and disposal procedures for both material collected on on-going projects and for future lettings. The testing of samples collected in accordance with the following instructions will enable us to make increasingly valid determinations of the level of assurance of the testing.

  Legal Affairs also informs us that in response to the above information we are allowed to proceed in a rational manner considering both the effects and costs for each individual situation.

Therefore, for this interim period, and in order to get work back underway in a manner consistent with environmental requirements, the affected projects should be reviewed separately and considered by each of you in accordance with the following general guidance.

1. For those structures where the contract requires environmental protection (Items 570.07 and 570.08), the contractor, in the ordinary case, should be directed to comply with the provisions of the attached specification for Temporary Storage of Paint Removal Waste. An agreed price should be

negotiated, if possible, to provide equitable compensation for this changed requirement. Inasmuch as the contractor will no longer be required to remove all waste materials from the project site and dispose of such materials pursuant to the specification requirements for Items 570.07 and 570.08, consideration should be given to this fact during price negotiations. If a reasonable price cannot be negotiated, the work should be done by force account in accordance with Section 109-05 of the Standard Specifications.

2. The toxicity of significant amounts of paint removed by other methods than blasting is much less in doubt. Scraping large areas in lieu of blasting is significant. Therefore, where such is the case, the residue should be collected and stored at the site or the painting and preparation items deleted. The relatively minor amounts of paint displaced by drilling and preparation for field welding in rehabilitation projects, or displaced by manual methods during bridge inspections, in the usual case, need not be considered significant.

3. As recommended by the Office of Legal Affairs, other removal and painting work not subject to the above must be reviewed on an individual basis, with the goal of taking rational actions during this interim period while long term storage and disposition options are developed. The objective is to make all reasonable arrangements to contain and temporarily store the material that must be removed during this interim period. If general cleaning and painting can reasonably be delayed to later in the contract work after the long term solutions have been developed, it should be. But each of you knows the project best and those threshold decisions should be made by you. Criteria for your decision should include: the amount of work remaining on that contract, the criticality of the work itself, the cost of adding protection as a new item vs. reletting, the Region's funding allocation for painting and the significance of additional costs to the original contract amounts. Allowing limited startup (no longer than one working day), so that waste material can be collected and tested to evaluate the toxicity of that particular site should also be considered. Material that does not test

not test above EPA limits can be disposed of in accordance with the existing contract requirements.

Please be cognizant of the fact that some contracts may include environmental protection on some bridges and not others; also, that some bridges may have only partial protection.

Additional guidance as to testing, longer term storage and disposition of the stored material will be issued within a matter of weeks. Necessary revisions to new painting contracts are under development and should also be available within the same timeframe. Questions concerning ongoing projects should be referred to the Construction Division.

RS:JLL:dak

File: 1-JLL-Reg.Directors

cc: P. Taylor, Exec. Deputy Comm., 5-5Ø6
C. J. Clemente, Dep. Comm. & Special Coun., 5-5Ø9
J. K. Mladinov, Exec. Counsellor to Comm. 5-5Ø5
C. E. Carlson, Deputy Comm., 5-6th flr.
All ASCOMS
All Division Directors
D. Egan, Prog. Plann. & Mgmt. Group, 5-514B
T. Hulbert, Office of Communications, 5-524
K. Shiatte, Construction Division, 4-1Ø1
D. Geoffroy, Tech. Services, 7A-21Ø
D. Massimilian, Structures Div., 5-6th Flr.
T. Clash, Chief of Staff, 5Ø5
A. Hyland, 5-5Ø1A
G. McVoy, Environ. Analysis, 5-5Ø3
W. MacTiernan, Office of Legal Affairs, 5-5Ø9
All Regional Construction Engineers, Region ___

1857C.09 TEMPORARY STORAGE OF PAINT REMOVAL WASTE

1. Description
This work shall consist of the storage of all waste collected under Section 570-3.05, Environmental Ground Protection and Section 570-3.06, Environmental Waterway Protection.

2. Materials
Storage Drums: These shall consist of steel drums having a removable lid and conforming to I.C.C. Specification 17-H, (55 Gallon).

3. Construction Details
All material collected under 570-3.05 and 570-3.06 shall be deposited in storage drums. This requirement supersedes 570-3.05(E.) and 570-3.06(D).

The frequency of collection and storage of the paint removal waste shall depend on the rate of generation and containment techniques. As a minimum, the waste shall be collected and stored at the end of each working day in the storage drums such that no waste is left exposed overnight.

The waste shall be covered with a tarp and kept dry at all times. Storage drums shall have lids attached except when being filled.

All drums containing waste shall be labelled with attention size lettering in the following manner:

"WARNING: CONTAINS LEAD, MAY BE HARMFUL IF EATEN OR INGESTED"

All drums containing waste shall be sealed with a tamper-proof fastener and stored at the project site in a location determined by the Engineer.

4. Method of Measurement. Payment will be made based on the number of storage drums filled.

5. Basis of Payment. The unit price bid per filled storage drum shall include all labor, materials and equipment necessary to complete the work.

TO: R. Simberg, Office of Engineering, 503-5

FROM: C. J. Clemente, Office of Legal Affairs, 509-5

SUBJECT: BLAST MATERIAL FROM BRIDGE PAINTING PROJECTS

DATE: May 9, 1988

This will serve as a response to your inquiry concerning the appropriate action which the Department must take to ensure that lead-based paint waste is properly removed on all Department contracts.

Part 371 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York requires that solid waste which exhibit characteristic of EP toxicity be the subject of special handling and disposal. Recent EP toxicity tests, which have been performed on sample used blast material from different sites have indicated various levels of lead content. Therefore, used blast material, may or may not on a case-by-case basis, meet the definition of a waste requiring special handling and disposal. Testing of material from specific jobs may be required.

In the interim, until a Department policy can be established and implemented regarding these materials which have the potential to require special handling, we should be making reasonable efforts to collect and temporarily store these paint/sand waste from paint removal operation sites including ongoing rehabilitation and painting projects where we may be generating substantial material.

CJC:cb

APPENDIX D - SAMPLING PAINT REMOVAL WASTE

SAMPLING PAINT REMOVAL WASTE

The attribute of concern regarding the waste is the leachable lead content, which is correlated to the proportion of paint to inert material in the waste. That proportion varies considerably depending on the removal procedure employed, the condition of the paint system, and the condition of the steel. For an individual bridge these factors will vary considerably along the structure such that the proportion of paint in the waste will also vary considerably as the work progresses. However, for disposal purposes the waste from a single bridge is the smallest unit of concern. This means that the sample taken to determine the leachable lead content of the waste must be representative of the entire bridge. Although the waste may be segregated into containers for disposal purposes, there is no significance to the lead content of the waste in any individual container. Because the sampling and testing of this waste is a costly process, and because there is no statistical or practical meaning associated with the lead content of individual containers, a single composite sample of the waste is to be tested.

To create the composite sample a number of individual samples representing a reasonable cross section of the waste must be taken. In the absence of any statistical basis for determining the number of samples to be taken, a prudent, rational approach conforming to ASTM E105, Standard Recommend Practice for Probability Sampling of Materials will be utilized. Depending on the removal procedures used and the size of the containers, we can expect that a bridge may generate from 1 to 100 containers of waste. For bridges which generate 50 or more containers, sampling one in every ten would yield a reasonable approximation of the entire waste. However for bridges that generate less than 50 containers, one in ten is a potentially unrepresentative sample. Therefore, to be consistent, it will be required that a minimum of 5 containers be sampled for lots of 5 to 49 containers. For lots with less than 5 containers, each container should be sampled. The resulting sampling plan follows:

Lot = Total Waste Generated on a Single Bridge

Lot Size, No. of Containers	0-4	5-49	50 or more
No. of Containers to be sampled	All	5	1 in 10

The containers to be sampled should be selected at random using a random number table. The selected containers should then be opened and a shovelful of waste should be dug from the center of the container. There is no information available which would suggest segregation of the waste within the container is a significant problem. The waste sampled from all the containers should be combined and reasonably blended. The combined sample should then be reduced in size by quartering to yield a two quart sample. The sample should be split again to yield two

identical one quart samples. The samples should be placed in metal one quart cans with friction fit lids. One container will be shipped to a laboratory selected by the Department for toxicity testing. The second container should be retained at the job site by the Engineer pending a final determination on the disposition of the waste.

APPENDIX E - HAZARDOUS WASTE DETERMINATION FOR PAINT REMOVAL WASTE

HAZARDOUS WASTE DETERMINATION FOR PAINT REMOVAL WASTE

The regulated allowable level of lead in solid waste is less than 5 ppm. At a level of 5 ppm or greater the waste is determined by DEC regulations to be a hazardous waste which requires special handling and disposal. The determination is based on the results of the EP Toxicity Test. In a previous testing program the Department found the results of the EP Toxicity Test to be highly variable. The population standard deviation (σ) based on tests performed by a single laboratory was estimated at 3.16. The Department has also estimated the cost of disposal of the waste, when found to be toxic, to approximate the total cost of painting the bridge. Finally, the volume of hazardous waste disposal areas available for all disposal is finite and decreasing, such that inappropriate disposal of non-hazardous waste in the limited hazardous waste sites is not in the best public interest. The hazardous waste determination must take into consideration the testing variability and the high cost of erroneously requiring that non-toxic paint removal waste be treated as a hazardous waste.

To account for the effect of the testing variability, the determination will be based on a statistical test of the hypothesis that the lead content of the waste is less than 5 ppm. Because the population variance noted above is only an estimate, the confidence limits of the estimate were calculated using a X^2 distribution. With a confidence of 50%, the lower limit of the estimate of the population standard deviation is 2.86. Using the lower limit as the estimate of the standard deviation for the toxicity test is a conservative assumption because it implies greater precision can be expected in the test results than was demonstrated in the test program.

To test the hypothesis that a given lot of waste has a lead content less than 5 ppm, the random variable Z is used, where

$$z = \frac{(x-\mu_o)\sqrt{n}}{\sigma}$$

x = sample mean,
μ_o = 5 ppm lead content, the standard,
n = number of samples, and
σ = population standard deviation.

The value of z to be used in making the determination depends on the risk (α) assigned to the error of requiring non-hazardous waste to be treated as hazardous waste, e.g. 1 in 2, 1 in 10, 1 in 100, 1 in 1000, etc.. The following table gives the criteria for determination of the treatment required for various values of the risk. The sample size is 1 and the sample mean is the single test result.

Level of Acceptable Error	Test Statistic	Test Result Required to Classify Waste as Toxic
α	z	x
1 in 10,000	3.72	15.64
1 in 1,000	3.09	13.84
1 in 100	2.33	11.66
1 in 10	1.28	8.66
1 in 2	0.0	5.

Considering the minimal danger associated with the disposal of the paint removal waste in an unsecured landfill under the conditions simulated by the EP Toxicity Test, and the enormous cost of inappropriately treating non-hazardous waste as hazardous waste, it is reasonable to select a risk of no more than 1 in 10 that this mistake occurs. Therefore, for paint removal waste samples which have leachable lead contents of less than 8.66 according to the EP Toxicity Test, the hypothesis that the waste has a lead content below 5 ppm can not be rejected. That would mean that such debris would be determined not to be a hazardous waste requiring special treatment and disposal.

In the absolute case where 5 ppm is rigidly enforced, the risk associated with inappropriate disposal of a non-hazardous waste is 1 in 2 or 50%. That means that almost one half of the time the Department encounters a test result only slightly greater than 5 ppm, it will actually be dealing with a non-hazardous waste. Due to the enormous costs involved in hazardous waste disposal of this volume of debris, the diminishing space available to handle much more hazardous materials, and the extremely small possibility of environmental damage associated with the disposal of the debris in an uncontrolled landfill, it is recommended that the results from a test be 8.66 ppm or greater before the material is disposed of as a hazardous waste.

APPENDIX F - BRIDGE PAIN TING AND PAINT REMOVAL - OTHER STATES' EXPERIENCE

May 26, 1988

Q: What paint system are you currently using?

Texas:	Still use lead paints, mainly epoxy zincs made up of red lead/zinc yellow. Some special structures have inorganic zinc paints.
Minnesota:	Formerly used a red lead/iron oxide paint. Currently are using an organic zinc-rich painting system.
Massachusetts:	New steel and "major reconstruction" bridges are painted with inorganic zinc primer, a wash coat, and a vinyl (high build). Lead based paint is still used for maintenance purposes.
Virginia:	Major jobs use either a zinc/epoxy/polyester, a zinc/vinyl/vinyl, or a zinc/mastic/mastic system. For spot cleaning, an alkyd based primer with Micaceous Iron Oxide intermediate and top coat is used.
North Carolina:	Use inorganic zinc and vinyl or coal tar on new structures. Have used lead based paint for small touch-ups.
California:	Use water borne emulsion primers and acrylic finishes. Mostly zinc phosphate pigments.
Pennsylvania:	Use water based zinc primers, epoxy intermediates, and urethane topcoats for new steel. Epoxy mastic/urethanes for maintenance work.
Michigan:	Use organic zinc primer/epoxy intermediate/urethane topcoat or all new and existing steel.
Ontario:	Use inorganic zincs with a tie coat and two coats of vinyl for plate-girder type structures. Use epoxy zincs with two coats of vinyl for truss-type structures.

Q: Are you making statewide provisions to collect (contain) lead base paint removal wastes?

Texas: No real regulations. Containment is only done at a few sites in urban areas where dust could drift out over nearby buildings.

Minnesota: Only containment now done is over certain waterways where it is required by the Pollution Control Agency. A committee of engineers and contractors is considering changing this policy.

Massachusetts: All lead based paint removed is considered hazardous waste. The contractor is responsible for containment and disposal. In most cases the ground around the site is draped and the waste is allowed to fall onto it.

Virginia: Contracts state only that the contractor will obey all laws for handling of waste. The attention that is paid to this varies from district to district. However, the state is working on a stricter, more uniform policy.

North Carolina: No real regulations, although there hasn't been any open sandblasting for over three years. Present policy seems to be whatever the contractor can get away with. Are planning a policy in which the contractor will propose a containment method to be approved by NCDoT's air and water unit.

California: The contractor is responsible for proposing a containment method and contacting environmental organizations to get their approval.

Pennsylvania: Designers visit the site to determine what containment method will be included in the proposal, and this decision is reviewed by the environmental people prior to letting. In most areas, debris is simply allowed to drop to the ground and is then collected periodically.

Michigan: Contractors must contain spent abrasives, which are then collected into barrels, tested, and disposed of accordingly.

Ontario: In-house environmental specialists decide what level of containment to use, depending on the sensitivity of the area. Levels of containment are partial enclosure, full enclosure, or full enclosure with negative pressure.

Q: Do you require containment/collection/disposal of paint removed during routine maintenance operations other than painting?

Texas:	No.
Minnesota:	No.
Massachusetts:	No particular requirements.
Virginia:	No particular requirements.
North Carolina:	No particular requirements.
California:	Occasionally required, but, in the one case mentioned, the contractor stated that all debris had been blown away by the wind.
Pennsylvania:	Generally, yes.
Michigan:	Required if the quantity of waste generated is greater than about 5 gallons.
Ontario:	Required over rivers even if only small amounts of paint removal are involved which could fall into the flow.

Q: What overall increase in cost to painting operations is directly attributable to the containment and disposal of waste?

Texas: On a $1.69 million project involving 3780 tons of steel, less than 1% of the cost was due to con-tainment and disposal. Waste disposal cost was about $200/barrel if a landfill would accept the waste, and $500/barrel if it had to be incinerated.

Minnesota: Estimated that collection/containment/disposal of waste would add an additional $.50-1.00/$ft^2$ to the current cost for cleaning and painting of $1.00-1.50/$ft^2$.

Massachusetts: Estimated a disposal cost of $5000/truckload. There will be about one truckload of waste for an average job.

Virginia: Recent bid for blasting, spot priming, topping, and containment was $220/ton, versus $90-100/ton without containment.

North Carolina: Estimates that pollution control measures double the cost of a project.

Pennsylvania: Estimates that collection/containment/disposal adds 30-47% to the cost of a project.

Michigan: $150/cubic yard for disposal of hazardous waste, for which the contractor is paid separately. Otherwise, disposal is included in a lump sum for cleaning and collection of $2/$ft^2$ for non-urban areas and $3/$ft^2$ for urban areas.

Ontario: Estimates that collection/containment disposal increases the cost of a project by 10-20% normally, or by up to 50% for special situations.

APPENDIX G - WASTE SAMPLING AND TESTING FIRMS

SAMPLING

Assumptions:

1. 40 hr. work week.
2. 8 samples taken per week.
3. 880 miles travel per week to and from contract site.
4. 500 miles travel per week collecting samples.

Firm	Mileage	Labor	Meals/ Lodging	Weekly Total	Cost per Sample
KTA-Tater	328	800	255	1373	172
R. W. Hunt	304	800	255	1359	170
Pittsubrgh Testing Labs	328	880	255	1453	182
S. G. Pinney	345	1280	255	1880	235

EP TOX TESTING

LABORATORIES	DEC [1] APPROVED	ASTM [2] LISTED	EP TOX EXPERIENCE
Volumetric Techniques	X	X	X
KTA-Tater		X	X
S. G. Pinney			X
Friend Laboratory	X	X	X
Acts Testing Labs		X	X
Buffalo Testing Lab		X	X
Cambridge Analytical	X	X	X

1. Firms on the NYSDEC list of Technically Acceptable Laboratories.

2. Firms that can do chemical analysis, spectrographics and have experience with environmental materials.

Recommend retaining firms with marks in all three columns.

APPENDIX H - ALTERNATE NON-TOXIC PAINT STYSTEM - LIFE CYCLE COST

"LEAD FREE PAINT SYSTEM"

"PAINTING SYSTEMS FOR STRUCTURAL STEEL"

MEMORANDUM
DEPARTMENT OF TRANSPORTATION

TO: Richard Simberg, Office of Engineering, Room 504, Bldg. 5

FROM: Donald N. Geoffroy, Technical Services Division, Room 210, Bldg. 7A

SUBJECT: LEAD FREE PAINT SYSTEM

DATE: May 17, 1988

On May 6, 1988, I provided you with a paper prepared by the Materials Bureau and the Structures Division which proposed implementing a "high performance" epoxy lead-free paint system for all future bridge painting. That paper included cost comparisons on a per square foot basis between the lead base paint system and the epoxy paint system, but did not provide an annual program fiscal impact.

BAMS indicates that in calendar year 1987, the Department painted 323 bridges, consisting of 18 new bridges and 305 existing bridges. The average cost to paint the new bridges was $69,866 per bridge and the average cost to paint an existing bridge was $22,727 per bridge. As indicated in the paper, the increase in cost to paint a new bridge with the epoxy paint system is 57 percent. For an existing bridge, the increase is 26 percent.

Attachments 1 and 2 are the results of a life cycle cost analysis for painting existing bridges with both the lead base paint system and the epoxy systems. Table 1 summarizes the economic analysis for an annual program to repaint 300 existing bridges.

I am advised that all the large paint manufacturers can provide the epoxy paint system and that there should not be a supply problem caused by implementing a new paint system.

I therefore recommend that the epoxy paint system be used for all future bridge painting. If you approve, I'll have the appropriate EI drafted for your signature to implement this recommendation.

DNG/bpb
Attachments

cc: C. J. Clemente, Room 509, Bldg. 5
J. J. Thomas, Room 217, Bldg. 5
C. E. Carlson, 6th Floor, Bldg. 5
K. W. Shiatte, Room 101, Bldg. 5
J. M. Yourno, Room 405, Bldg. 5
D. J. Egan, Room 514B, Bldg. 5
G. R. McVoy, Room 303, Bldg. 5
T. Hulbert, Room 524, Bldg. 5
W. Brule, Room 210, Bldg. 7A
A. E. Hyland, Room 501A, Bldg. 5

ATTACHMENT 1

MAINTENANCE PAINTING LIFE CYCLE COST COMPARISON FOR THE "AVERAGE" BRIDGE

Using a 10-year service life for the current alkyd system and a 20-year service life for the proposed system and a present worth factor of 5%:

Year	Alkyd System	Proposed System
0	$22,727.63	$28,636.81
10	$13,952.49	$ -
20	$ 8,563.77	$10,790.35
30	$ 5,259.17	$ -
40	$ 3,227.32	$ 4,066.43
50	$ 1,981.85	$ -
60	Bridge is Replaced	
Lifetime Cost* =	$55,712.23	$43,493.59
Cost/year* =	$ 928.54	$ 724.89

*These costs are in 1987 dollars.

ATTACHMENT 2

MAINTENANCE PAINTING LIFE CYCLE COST COMPARISON FOR THE "AVERAGE" BRIDGE

Using a 10-year service life for the current alkyd system and a 15-year service life for the proposed system and a present worth factor of 5%.

Year	Alkyd System	Proposed System
0	$22,727.63	$28,636.81
10	$13,952.49	$ -
15	$ -	$13,774.31
20	$ 8,563.77	$ -
30	$ 5,259.17	$ 6,626.56
40	$ 3,227.32	$ -
45	$ -	$ 3,187.18
50	$ 1,981.85	$ -
60	Bridge is replaced	
Lifetime Cost* =	$55,712.23	$52,224.86
Cost/year* =	$ 928.54	$ 870.41

*These costs are in 1987 dollars.

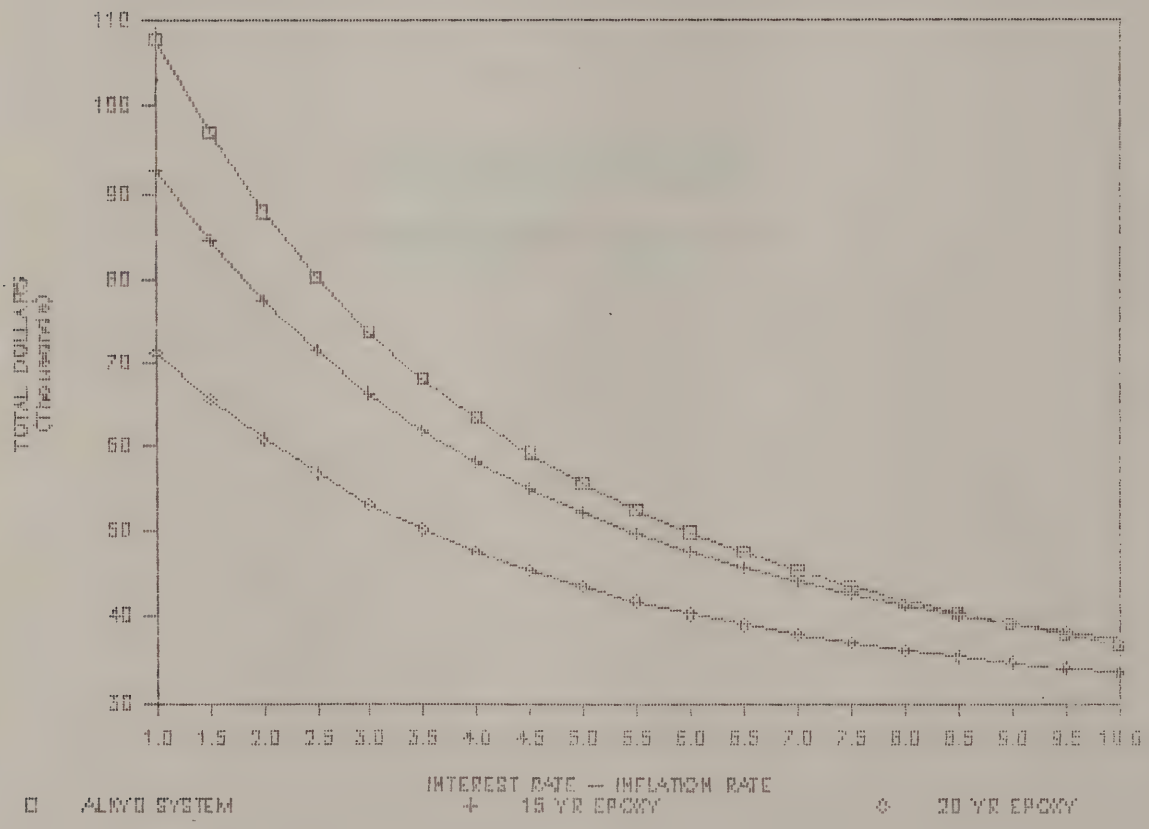
TABLE 1 - ECONOMIC COMPARISON OF PAINT SYSTEMS

	Lead Base Alkyd Service Life-10yrs.	Epoxy Paint System Service Life-15yrs.	Epoxy Paint System Service Life-20yrs.
First Cost Per Bridge	$22,730	$28,636	$28,636
Program First Year Costs	$6,819,000	$8,590,800	$8,590,800
Annualized Cost Per Bridge	$928.54	$870.41	$724.89
Annualized Program Cost	$278,562	$261,123	$217,467
60-Year Lifetime Cost Per Bridge	$55,712	$52,224	$43,493

Additional Life Cycle Costs

at Alternate Discount Rates

TOTAL DOLLARS VS DIFFERENCE BETWEEN INTEREST RATE & INFLATION RATE



MAINTENANCE PAINTING LIFE CYCLE COST COMPARISON FOR THE "AVERAGE" BRIDGE

ASSUME DIFFERENCE BETWEEN INTEREST RATE & INFLATION RATE EQUALS 10 PERCENT

YEAR	ALKYD SYSTEM	15 YR PROPOSED SYSTEM	20 YR PROPOSED SYSTEM
0	$ 22727.63	$ 28636.81	$ 28636.81
10	$ 8762.49	-	-
15	-	$ 6855.42	-
20	$ 3378.32	-	$ 4256.68
30	$ 1302.49	$ 1641.13	-
40	$ 502.17	-	$ 632.73
45	-	$ 392.87	-
50	$ 193.61	-	-
60		BRIDGE IS REPLACED	
LIFETIME COST* =	$ 36866.69	$ 37526.24	$ 33526.22
COST/YEAR* =	$ 614.44	$ 625.44	$ 558.77

* THESE COSTS ARE IN 1987 DOLLARS.
COST/YEAR IS BASED ON 60 YEAR BRIDGE LIFE

FIRST COST PER BRIDGE =	$ 22730.00	$ 28636.00	$ 28636.00
PROGRAM FIRST YEAR COSTS =	$6819000.00	$8590800.00	$8590800.00
ANNUALIZED COST/BRIDGE =	$ 614.44	$ 625.44	$ 558.77
ANNUALIZED PROGRAM COST =	$ 184333.46	$ 187631.22	$ 167631.09
60 YR LIFETIME COST/BRIDGE =	$ 36866.69	$ 37526.24	$ 33526.22

MAINTENANCE PAINTING LIFE CYCLE COST COMPARISON FOR THE "AVERAGE" BRIDGE

ASSUME DIFFERENCE BETWEEN INTEREST RATE & INFLATION RATE EQUALS 7 PERCENT

YEAR	ALKYD SYSTEM	15 YR PROPOSED SYSTEM	20 YR PROPOSED SYSTEM
0	$ 22727.63	$ 28636.81	$ 28636.81
10	$ 11553.57	-	-
15	-	$ 10379.30	-
20	$ 5873.25	-	$ 7400.30
30	$ 2985.66	$ 3761.94	-
40	$ 1517.76	-	$ 1912.38
45	-	$ 1363.50	-
50	$ 771.55	-	-
60		BRIDGE IS REPLACED	
LIFETIME COST* =	$ 45429.43	$ 44141.54	$ 37949.48
COST/YEAR* =	$ 757.16	$ 735.69	$ 632.49

* THESE COSTS ARE IN 1987 DOLLARS.
COST/YEAR IS BASED ON 60 YEAR BRIDGE LIFE

FIRST COST PER BRIDGE =	$ 22730.00	$ 28636.00	$ 28636.00
PROGRAM FIRST YEAR COSTS =	$6819000.00	$8590800.00	$8590800.00
ANNUALIZED COST/BRIDGE =	$ 757.16	$ 735.69	$ 632.49
ANNUALIZED PROGRAM COST =	$ 227147.16	$ 220707.71	$ 189747.41
60 YR LIFETIME COST/BRIDGE =	$ 45429.43	$ 44141.54	$ 37949.48

MAINTENANCE PAINTING LIFE CYCLE COST COMPARISON FOR THE "AVERAGE" BRIDGE

ASSUME DIFFERENCE BETWEEN INTEREST RATE & INFLATION RATE EQUALS 6 PERCENT

YEAR	ALKYD SYSTEM	15 YR PROPOSED SYSTEM	20 YR PROPOSED SYSTEM
0	$ 22727.63	$ 28636.81	$ 28636.81
10	$ 12690.99	-	-
15	-	$ 11949.14	-
20	$ 7086.58	-	$ 8929.09
30	$ 3957.11	$ 4985.96	-
40	$ 2209.63	-	$ 2784.13
45	-	$ 2080.47	-
50	$ 1233.85	-	-
60		BRIDGE IS REPLACED	
LIFETIME COST* =	$ 49905.79	$ 47652.38	$ 40350.04
COST/YEAR* =	$ 831.76	$ 794.21	$ 672.50
FIRST COST PER BRIDGE =	$ 22730.00	$ 28636.00	$ 28636.00
PROGRAM FIRST YEAR COSTS =	$6819000.00	$8590800.00	$8590800.00
ANNUALIZED COST/BRIDGE =	$ 831.76	$ 794.21	$ 672.50
ANNUALIZED PROGRAM COST =	$ 249528.94	$ 238261.88	$ 201750.18
60 YR LIFETIME COST/BRIDGE =	$ 49905.79	$ 47652.38	$ 40350.04

* THESE COSTS ARE IN 1987 DOLLARS.
COST/YEAR IS BASED ON 60 YEAR BRIDGE LIFE

MAINTENANCE PAINTING LIFE CYCLE COST COMPARISON FOR THE "AVERAGE" BRIDGE

ASSUME DIFFERENCE BETWEEN INTEREST RATE & INFLATION RATE EQUALS 5 PERCENT

YEAR	ALKYD SYSTEM	15 YR PROPOSED SYSTEM	20 YR PROPOSED SYSTEM
0	$ 22727.63	$ 28636.81	$ 28636.81
10	$ 13952.79	-	-
15	-	$ 13774.80	-
20	$ 8565.80	-	$ 10792.91
30	$ 5258.66	$ 6625.91	-
40	$ 3228.36	-	$ 4067.74
45	-	$ 3187.18	-
50	$ 1981.93	-	-
60		BRIDGE IS REPLACED	
LIFETIME COST* =	$ 55715.18	$ 52224.69	$ 43497.46
COST/YEAR* =	$ 928.59	$ 870.41	$ 724.96

* THESE COSTS ARE IN 1987 DOLLARS.
COST/YEAR IS BASED ON 60 YEAR BRIDGE LIFE

FIRST COST PER BRIDGE =	$ 22730.00	$ 28636.00	$ 28636.00
PROGRAM FIRST YEAR COSTS =	$6819000.00	$8590800.00	$8590800.00
ANNUALIZED COST/BRIDGE =	$ 928.59	$ 870.41	$ 724.96
ANNUALIZED PROGRAM COST =	$ 278575.92	$ 261123.47	$ 217487.29
60 YR LIFETIME COST/BRIDGE =	$ 55715.18	$ 52224.69	$ 43497.46

MAINTENANCE PAINTING LIFE CYCLE COST COMPARISON FOR THE "AVERAGE" BRIDGE

ASSUME DIFFERENCE BETWEEN INTEREST RATE & INFLATION RATE EQUALS 4 PERCENT

YEAR	ALKYD SYSTEM	15 YR PROPOSED SYSTEM	20 YR PROPOSED SYSTEM
0	$ 22727.63	$ 28636.81	$ 28636.81
10	$ 15353.97	-	-
15	-	$ 15901.00	-
20	$ 10372.59	-	$ 13069.47
30	$ 7007.35	$ 8829.26	-
40	$ 4733.92	-	$ 5964.73
45	-	$ 4902.58	-
50	$ 3198.06	-	-
60		BRIDGE IS REPLACED	
LIFETIME COST* =	$ 63393.53	$ 58269.65	$ 47671.01
COST/YEAR* =	$ 1056.56	$ 971.16	$ 794.52

* THESE COSTS ARE IN 1987 DOLLARS.
COST/YEAR IS BASED ON 60 YEAR BRIDGE LIFE

FIRST COST PER BRIDGE =	$ 22730.00	$ 28636.00	$ 28636.00
PROGRAM FIRST YEAR COSTS =	$6819000.00	$8590800.00	$8590800.00
ANNUALIZED COST/BRIDGE =	$ 1056.56	$ 971.16	$ 794.52
ANNUALIZED PROGRAM COST =	$ 316967.65	$ 291348.27	$ 238355.05
60 YR LIFETIME COST/BRIDGE =	$ 63393.53	$ 58269.65	$ 47671.01

TO: D. J. Massimilian, Structures Design, 6th Flr., Bldg. 5 w/att

FROM: J. J. Murphy, Materials Bureau, Rm. 210, Bldg. 7A

SUBJECT: PAINTING SYSTEMS FOR STRUCTURAL STEEL

DATE: October 30, 1987

Attached is a proposal for the use of high performance type paint systems on structural steel. If the recommendations included in this proposal are adopted, the lead-oil/alkyd type paint system that the Department now specifies would be eliminated.

This proposal has been developed as a joint effort between L. Johanson and R. Ecuyer of your Division, together with members of my staff. We believe that the recommended materials and methods will be cost-effective, reduce bridge maintenance and minimize environmental problems.

We suggest that you review this proposal to determine if a change in painting systems is desirable. If the recommendations are acceptable, we request that your office assume the lead in presenting this proposal to Mr. Simberg and other groups in the Department (Maintenance, Waterways, Construction, etc.). We are available to participate in any meetings to provide clarification and technical input and to work out details of implementation.

JJM:DRB:MTS
FILE: 8

Attachment(10)

cc: L. N. Johanson, Bridge Design, 6th Flr., Bldg. 5 w/att(1)
R. L. Ecuyer, Bridge Design, 6th Flr., Bldg. 5 w/att(1)

bcc: J. J. Murphy w/att(1)
W. J. Brule w/att(1)
D. K. Richards w/att(1)
D. R. Brewster w/att(1)
W. A. Snyder w/att(1)

PAINTING SYSTEMS FOR STRUCTURAL STEEL

MATERIALS BUREAU
OCTOBER, 1987

This paper is a proposal for the use of "high performance" type paint systems on bridge steel. It is a general overview for Department management, and for bridge engineers, to demonstrate that improved coatings are desirable. The materials and methods included in this synopsis will reduce bridge maintenance, minimize environmental problems and provide aesthetically acceptable structures. A cost analysis is included that shows the proposed coatings are cost-effective over the life of the structure.

BACKGROUND

From its organization in 1926 and through 1957 there were few changes in the Department's paint formulations for bridge structures. During this period an oil based type paint with red lead pigment was specified to prevent corrosion. In 1956, an investigation of a then new "anti-corrosive" pigment, basic lead silico chromate, was undertaken. The basic lead pigment offered several advantages over red lead; it provided the same or better corrosion protection, it weathered better and it could be incorporated into finish paints to enhance color retention. Testing of paints formulated with basic lead continued into the 1960's, at which time it was adopted as the primary anti-corrosive pigment for use in the Department's bridge paints.

From that time (1960's) there have been few significant changes to our bridge painting requirements. The surface preparation (cleaning) standards for new steel have been upgraded to commercial blast cleaning and in 1984 a more durable coal tar epoxy paint was specified for use on structures exposed to wet conditions in the field. All other changes have been minor.

During this same time period paint technology has been rapidly improving. The lead pigmented oil/alkyd type paint systems such as the Department specifies have been replaced by a variety of high performance coatings (zinc, epoxy, urethane, etc.). These new paints offer a number of significant advantages:

- -they have a longer life
- -they offer better resistance to corrosion
- -most contain no lead or chromates
- -they comply to air pollution regulations
- -asthetically they are produced in all colors
- -they are cost effective

CURRENT TRENDS

Most State Departments of Transportation have been slow to take advantage

of the improvements made in coating technology. Only Michigan, Florida and a few other states have adopted the high performance type coatings. In New York our field experience with these newer paints is limited. In 1985-86, the Twin Arch bridges over the Mohawk River (I-87) were repainted using an epoxy/urethane system and in 1986 the 112th Street Bridge (N. Troy) was coated with an epoxy-mastic/urethane system. No problems were encountered with these applications. Future use of these high performance type coatings is scheduled for several projects including the repainting of the Brooklyn and Queensboro bridges in NYC.

The primary reason for considering a change to the Department's painting system is to obtain longer and more cost effective service from our coatings. However, secondary factors that are becoming increasingly important include environmental concerns over lead, hexavalent-chromium-based pigments and photochemically reactive solvents (VOC's or volatile organic compounds). Over the past decade the U.S. Environmental Protection Agency, and this State's Department of Environmental Conservation, have introduced stringent regulations to control these substances. For example the allowable amount of lead and chromium in a typical household paint is "nil" and similar law is being introduced for architectural (bridge) coatings. Likewise the quantity of volatile organic compounds (solvent) allowed in any paint is now 3.5#/gal. and legislation has been introduced that will reduce this limit to 2.0 to 2.5#/gal.. With these pending regulations it is doubtful that New York, or any state can continue to specify a lead-oil/alkyd type paint system. Because of environmental law it is likely that this type of paint formulation will not be available in the future.

PROPOSED PAINTING PROGRAM

Five painting systems are proposed for use. One for painting new steel; one for repainting existing bridges that are already coated with our standard oil/alkyd type paint; one for touch-up painting of existing A-588 steel that may have begun to rust excessively; and two for painting new or existing steel subject to immersion and underground service.

Each of these systems together with an explanation of why they are preferred over other types of high performance paints are discussed below. All coating materials will be formulated without lead or chromium pigments and will conform to current and pending air pollution regulations.

1. NEW STEEL

A three coat, shop applied paint system consisting of an inorganic zinc-rich primer, an epoxy-polyamide intermediate coat and a urethane finish coat is recommended. The surface preparation (cleaning) for this system will require a near-white blast (SSPC-SP 10).

This system is for all grades of steel that are specified for painting (A36, A588, etc.), except for steel that will be exposed to immersion and underground service.

The inorganic zinc primer is preferred over an organic zinc formulation because of it's superior bond with the cleaned steel. Inorganic formulations will chemically react with the steel surface to form a permanent bond that is resistant to under-cutting (lifting) of the coating by corrosion. Organic zincs do not react chemically and are prone to the same type of failure as an oil/alkyd coating (lifting, blistering, etc.). Also, because of their strong bond inorganic zincs have high coefficients of friction and can be painted on faying surfaces.

The choice of the epoxy intermediate and the urethane finish paints is based on cost effectiveness, their compatibility with the zinc primer (and themselves) and long service lives.

Total shop painting is recommended to improve quality control and minimize environmental problems. Total shop painting is considered less costly than a combination of shop and field coating work and Michigan has adopted this procedure with excellent results.(1)

Other long-life coating systems are available but are not recommended for painting new steel for a number of reasons. Vinyl paints are excellent for immersion service but are "low solids" formulations (i.e. - 10+ wet mils must be applied to get 2 dry mils). The high quantity of solvent in the vinyl formulations would violate the EPA's requirements for the control of volatile organic compounds (VOC's). Vinyl paints have also historically had problems with intercoat adhesion and discoloration of the finish coat. The epoxy-mastic type paints are not good shop primers because of their long dry times (3 days @ 60F). By comparison steel painted with zinc primer can normally be handled within hours, and the next coating applied the following day.

Subsequent repainting of steel coated with this system (zinc/epoxy/urethane) would be performed using the epoxy-mastic and urethane coating system described in the following paragraph (2. EXISTING STEEL---).

(1) Tinklenberg, G. and Culp, J.D., "Michigans Answer: Total Shop Painting", Journal of Protective Coatings and Linings, June 1984, pp26-29
Griffin, D., "Coating Work in the Fabricating Shop", Journal of Protective Coatings and Linings, Sept. 1986, pp34-37.

2. EXISTING STEEL WITH OIL/ALKYD PAINT

For repainting existing steel an epoxy-mastic type paint is recommended for touch-up priming and as the first full field coat (intermediate). Urethane is recommended as the finish paint.

For this painting system the surface preparation requirements that are currently being specified will remain the same (commercial and brush-off blast). The epoxy-mastic is compatible with our existing and proposed paints. This is important as many high-performance paints are not compatible and would require complete removal of the applied coating, resulting in increased environmental problems and costs.

With this recommended painting system it should be noted that the use of coal tar epoxy (EI84-8) in critical (wet) areas will be eliminated. The epoxy mastic paint will provide equal performance in the same exposure condition.

3. EXISTING A-588 STEEL

Information on paint systems for corroded A-588 steel is limited. One of the best sources on this subject is the 2nd phase report prepared for the American Iron and Steel Institute entitled "Remedial Painting of Weathering Steel: State-of-the-Art Survey".

The recommendations in this study state that an inorganic zinc-rich primer, applied over blast cleaned steel (near-white) with coal tar epoxy topcoats is the best system to retard further corrosion. These paints are only intended for existing weathering type steels that show signs of injurious rust.

4 & 5. IMMERSION AND UNDERGROUND SERVICE (NEW AND EXISTING STEEL)

Coating systems for immersion and underground service are limited. All grades of steel in these environments should be painted. Inorganic zinc-rich primer with two coats of coal tar epoxy is the recommended system. It is the system currently being specified in Department work. If aesthetics are of consideration a four coat vinyl system could be used. For either system surface preparation will require cleaning to bare metal (SSPC-SP10 near-white blast). Oil/alkyds, other epoxies and urethanes are not intended for immersion service.

PAINTING COSTS

The following cost analysis provides a comparison between the Department's standard oil/alkyd painting system (hereinafter "alkyd") and the proposed systems for painting new steel and repainting existing steel. Because it will have limited use no cost for the touch-up painting of existing A-588 steel is presented. Also no costs for the protection of steel in immersion/underground service is provided as these systems are currently being used by the Department for painting in these situations.

The cost analysis is presented in two parts. First the direct or initial costs of painting are discussed without regard to economics; and second the true cost of corrosion protection, based on the total cost of maintaining the paint and steel over the structures life is presented. This latter analysis is based on the method of "Present Worth" and is calculated for both new and existing bridges.

Also, because painting work has historically been bid as a "lump sum" item, the actual cost of painting on Department projects is unknown. For this reason the following cost analysis is based on data from the Steel Structures Painting Council (Steel Structures Painting Manual, Volume 1, 1981). Since the published costs are in 1981 dollars, they have been directly increased by an assumed inflation of 5% per year through 1987 (total adjustment = 30%).

The alkyd type paints referenced in this analysis are the Department's current standard paints as specified under Section 570.

INITIAL (DIRECT) PAINTING COSTS

The painting system in this analysis is the total effort necessary to apply paint to the structure. It includes several components:

-paint materials
-surface preparation
-paint application
-inspection
-overhead, etc.

Inspection is performed by Department personnel, or their representatives, as part of their normal duties. Overhead would include contract preparation and related expenses borne by the Department. As indirect expenses inspection and overhead are not considered in comparing painting systems. Therefore only the direct costs are included in this analysis with the assumption that indirect costs are a constant percentage of the direct costs. The direct or initial painting costs for paint materials, surface preparation work and paint application are given in 1987 dollars in Tables 1, 2, and 3.

This analysis is a cost comparison of the standard alkyd type paint system with the proposed systems for painting new steel and for repainting existing steel only. Additional cost savings that may result from less frequent repaintings such as maintenance and protection of traffic, environmental protection and similar items are not accounted for.

TABLE 1 - PAINT MATERIAL COST - 1987

Paint Type	D.F.T. (Mils.)	Cost/SF[1]
Alkyd Primer	2.0	$0.060
Alkyd Intermediate	2.0	$0.060
Alkyd Topcoat	2.0	$0.039
Inorganic Zinc Primer	3.0	$0.144
Epoxy-Polyamide Intermediate	4.0	$0.188
Urethane Topcoat	3.0	$0.103
Epoxy Mastic Primer and Intermediate	5.0	$0.112

(1)Derived by adding 30% inflation factor to 1981 costs

TABLE 2 - SURFACE PREPARATION COSTS - 1987

Cleaning Grade	Cost/SF[1] Shop Cleaning	Field Cleaning
SSPC-SP7, Brush-Off Blast	---	$0.520
SSPC-SP6, Commercial Blast	$0.338	$0.893
SSPC-SP10, Near-White Blast	$0.403	---

(1)Derived by adding 30% inflation factor to 1981 costs.

TABLE 3 - PAINT APPLICATION COSTS - 1987

Paint Type	Cost/SF/Paint Coat[1] Shop Painting	Field Painting
Alkyd	$0.117	$0.211
Inorganic Zinc	$0.260	---
Epoxy-Polyamide	$0.195	$0.293
Epoxy Mastic	$0.195	$0.293
Urethane	$0.195	$0.293

(1) Derived by adding 30% inflation factor 1981 costs.

Table 4 provides the initial costs of painting new steel with the standard 3 coat alkyd system and the proposed zinc/epoxy-polyamide/urethane system. It is assumed that all 3 coats are applied in the shop and that 10% touch-up painting of the finish coat will be required in the field after erection.

TABLE 4 - INITIAL PAINTING SYSTEM COSTS FOR NEW STEEL
(SHOP PAINTING 3 COATS - 10% FIELD TOUCH-UP)

Paint System	Material	Surface Preparation	Application	Total Cost/SF
3 Coat Alkyd (SSPC-SP6)(2)	$0.163 (19%)(3)	$0.338 (39%)(3)	$0.371 (42%)(3)	$0.872(1)
Zinc/Epoxy/Urethane (3 Coat System)(2) (SSPC-SP10)	$0.361 (25%)(3)	$0.403 (28%)(3)	$0.670 (47%)(3)	$1.434(1)

(1) Includes cost of touch-up painting of finish coat in field (estimated at 10%).
(2) Surface preparation (cleaning) grade.
(3) Percent of total system cost per square foot.

As evidenced the total initial cost for the proposed zinc/epoxy-polyamide/urethane system is $1.434/SF as compared to $0.872/SF for the alkyd system. This represents an initial cost increase of 65% for painting work. The higher cost is attributed to the following: materials ($0.198); cleaning ($0.065); and application ($0.299).

Table 5 shows the repainting costs for existing steel with both the 3 coat alkyd paint system and the proposed epoxy mastic/urethane paint system. It is assumed that at the time of painting, the existing paint has deteriorated to the condition that 25% of the structure will require commercial blast cleaning to bare metal. The remaining 75% of the bridge will have intact paint and require brush-off blast cleaning. Painting will consist of touch-up priming on those areas cleaned to bare metal followed by one full intermediate coat of paint on the entire structure and one full topcoat.

TABLE 5 - INITIAL REPAINTING SYSTEM COSTS FOR EXISTING STEEL
(FIELD PAINTING - 25% TOUCH-UP PRIMING)

Paint System	Material	Surface Preparation	Application	Total Cost/SF
Alkyd (25%-SP6/[1] 75%-SP7)	$0.114 (9)[2]	$0.614 (51%)[2]	$0.475 (40%)[2]	$1.203
Epoxy Mastic/ Urethane (25%-SP6/[1] 75%-SP7)	$0.243 (16%)[2]	$0.614 (41%)[2]	$0.659 (43%)[2]	$1.516

(1) Percent cleaning - surface preparation grade
(2) Percent of total system cost per square foot

Table 5 again shows that the proposed system for repainting has a higher initial cost than the standard alkyd system ($1.516 vs $1.203 or 26%). This cost increase is due to materials ($0.129) and application ($0.184). The surface preparation costs for both systems are the same.

LIFETIME PAINTING COSTS

The preceeding has dealt with the initial cost of painting structural steel. The true cost of corrosion protection is the cost of maintaining the paint and steel over the structure's lifetime.

The repaint interval is the key parameter for this estimate. Based on past information from Highway Maintenance and recent conversations with Region bridge design and maintenance personnel the "average" life of the alkyd paint system is approximately 10 years. This average life occurs in environments considered to range from moderate to severe. In this same type of service the proposed paint systems have been estimated to last 20 years (2 times longer than the alkyd paints).

The true cost of corrosion protection must also account for the time value of money. Money can earn interest. The difference between the interest rate and inflation rate represents a rate of return on invested money. This rate of return is referred to as the Discount Rate. Costs incurred at some point in the future must be discounted to reflect their costs in current dollars. To discount future costs to current dollars, a Present Worth Factor is used. This factor is based on the discount rate and the number of years involved. The use of the Present Worth Factor as recommended in NCHRP Project 20-7/24, has been adopted by AASHTO for use in cost comparisons. The PWF adjusts the cost of an activity that will occur at some future date so that it can be compared to costs occurring today.

For this analysis a PWF based on a discount rate of 5% is used. This is the same value used by J. Vyce (ER & DB) in his report entitled "A Life-Cycle Cost Analysis for Asphalt and Concrete Pavements", and as recommended by R. Edwards (former Director, Fac. Design Division).

Using the PWF concept, Table 6 is a 60 year lifetime cost comparison for painting a new bridge with the alkyd and proposed paint systems. The alkyd has been assigned a life of 10 years and the proposed system is shown with a life of 20 years. The lifetime cost comparison is based on the painting schedule necessary to maintain corrosion protection on a bridge from the time it is erected through its design life. Using the standard alkyd system would require initial painting at year 0 (today) followed by repainting at years 10, 20, 30, 40, and 50. Using the proposed systems would require initial painting at year 0 followed by repainting at years 20 and 40. Consequently the use of either system would result in a bridge ready to be repainted at year 60. All painting costs are adjusted to todays dollars using the PWF. The initial painting costs are from Table 4 and the repaint costs are from Table 5.

TABLE 6 - 60 YEAR LIFETIME PAINTING COST FOR NEW STEEL
(10 YEAR ALKYD LIFE VS. 20 YR. PROPOSED SYSTEM LIFE)

Year	Net Present Worth (5%)	Alkyd System (10 Years)	Proposed System (20 Years)
0	$1.00	$0.872	$1.434
10	$0.6139	$0.739(1)	------
20	$0.3768	$0.453(1)	$0.571(2)
30	$0.2314	$0.278(1)	------
40	$0.1420	$0.171(1)	$0.215(2)
50	$0.0872	$0.105(1)	------
60	----------Bridge is Replaced----------		
	Lifetime Cost/SF =	$2.618	$2.220
	Cost/SF/Year =	$0.044	$0.037

(1) Based on a repaint cost of $1.203/SF in year 0.
(2) Based on a repaint cost of $1.516/SF in year 0.

As shown in Table 6 the net savings involved in using the proposed system in place of the alkyd system is $0.398/SF over the life of the structure or $0.007/SF/Year. It should be noted that the higher initial cost of the proposed system does not take 60 years to recover. This cost is fully recovered at the 10 year point in life at which time the structure coated with alkyd will receive its first repaint. Painting cost at the 10 year cycle is $1.611 vs $1.434 for a net savings of $0.177/SF for the proposed system from year 10 to 20. A similar analysis will show continued savings with the proposed system for the remaining life of the structure.

Again using the method of PWF, Table 7 is a 60 year lifetime cost comparison for an existing bridge with the alkyd and proposed paint systems. From Table 7, the net savings in using the proposed system in place of the alkyd system is $0.647/SF over the life of the structure or $0.011/SF/Year. Also, as noted in the previous discussion for painting new bridges the higher initial cost of the proposed system is completely recovered in 10 years when the structure coated with alkyd will receive its first repaint.

TABLE 7 - 60 YEAR REPAINTING PAINTING COST FOR EXISITNG STEEL
(10 YEAR ALKYD LIFE VS. 20 YR. PROPOSED SYSTEM LIFE)

Year	Net Present Worth (5%)	Alkyd System (10 Years)	Proposed System (20 Years)
0	$1.0000	$1.203	$1.516
10	$0.6139	$0.739(1)	------
20	$0.3768	$0.453(1)	$0.571(2)
30	$0.2314	$0.278(1)	------
40	$0.1420	$0.171(1)	$0.215(2)
50	$0.0872	$0.105(1)	------
60	----------Bridge is Replaced----------		
	Lifetime Cost/SF =	$2.949	$2.302
	Cost/SF/Year =	$0.049	$0.038

(1) Based on a repaint cost of $1.203/SF in year 0.
(2) Based on a repaint cost of $1.516/SF in year 0.

RECOMMENDATIONS:

Based on the information in this report the following recommendations appear warranted:

1. The current alkyd type paint system specified for painting structural steel should be replaced with high performance coating systems. The new coating systems will be cost effective and reduce environmental problems.

2. New steel should be painted all coats in the shop. For steel that is not subjected to immersion or underground service the paint system should consist of an inorganic zinc-rich primer, an epoxy-polyamide intermediate paint and a urethane finish paint.

3. Existing steel that is not subjected to immersion or underground service should be painted with an epoxy-mastic type paint for both touch-up and the first full field coat. The finish paint should be a urethane type coating.

4. For all steel (new and existing) in immersion or underground service the paint system should consist of either an inorganic zinc-rich primer with two coats of coal tar epoxy paint or a four coat vinyl paint system.

5. Weathering type steels that show signs of injurious rust should be spot-painted with an inorganic zinc-rich primer and two coats of coal tar epoxy.

REFERENCES:

1. Britton, H. B., "An Engineering Approach to Improved Protection of Structural Steel", HRB Record 140 (1966)

2. Steel Structures Painting Council, Volume 1, Good Painting Practice (1982)

3. Appleman, B. R., "Economics of Corrosion Protection by Coatings", Journal of Protective Coatings or Linings, March 1985, pp 21-33

4. Tinklenberg, G. and Culp, J. D. "Michigans Answer: Total Shop Painting", Journal of Protective Coatings and Linings, June 1984, pp 26-29

5. Griffin, D., "Coating Work in the Fabricating Shop", Journal of Protective Coatings and Linings, Sept. 1986, pp 34-37

6. Keane, J. D. et-al, "Remedial Painting of Weathering Steel: State-of-the-Art Survey", Steel Structures Painting Council, Feb. 1984

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